

REMARKS

Claims 21-50 remain in the application.

The dependencies of claims 43 and 44 have been amended to conform to the intent of amendment adding them, as is clear from the difference between method and apparatus. A purely editorial amendment has been made to claim 45.

The Examiner rejects claims 21, 22, 24, 27-29, 32-43, and 45 under 35 U.S.C. §103(a) as being obvious over Hsu et al. (U.S. Patent 5,589,039, hereafter Hsu) in view of Miyata (U.S. Patent 5,519,373) and Tepman (U.S. Patent 5,527,438). This rejection is traversed. The Examiner uses Miyata for the teaching that "a stationary magnet array ... results in a substantially parallel magnetic field about the target surface. (Figure 5, col. 5, line 1-12)" It is believed that the Examiner incorrectly interprets Miyata. Miyata's drawings are somewhat confusing in that he illustrates an inverted configuration in FIG. 3 of a wafer 28 placed above a target 26 (col. 4, lines 34, 35). Miyata's dipole ring magnet 100 produces at its middle a horizontal magnetic field with substantially no vertical components (col. 4, lines 38-42) and the target's vertical position is adjusted so the target surface is close to the middle of the ring magnet 100 (col. 4, lines 44-46). As a result, a plasma generating zone 30 is maintained over the target 26 (col. 4, lines 58-60). The uniform horizontal magnetic strength illustrated in Miyata's FIG. 5 is associated with the plasma generating zone 30 adjacent his target 26 and not adjacent his wafer 28. Although Miyata does not use the term, he is describing a magnetron formed by the dipole magnet ring promoting a high density plasma near the target.

Miyata nowhere describes a substantially horizontal magnetic field near his wafer 28. Indeed, as Miyata describes at col. 7, line 61-64 with reference to FIG. 15, the (magnetic) flux 70 is uniformly horizontal only near the middle cross section of his dipole magnet ring formed partially by magnets 101, 109, and this middle cross section is closely aligned with the target center. Away from the middle cross section and in particularly toward Miyata's wafer, the

magnetic field has increasingly significant vertical components.

The justification the Examiner provides for combining Miyata with Hsu is that Miyata's dipole ring enhances sputtering efficiency and allows for more economical use of costly target material. The statement is correct for Miyata's dipole ring magnetron but not for the claimed magnetic field. Miyata's description does not justify placing a magnet ring adjacent the substrate or at least placing the magnet ring to produce a horizontal magnetic field on the substrate surface. Nowhere is it taught that a magnet ring placed adjacent the substrate influences the sputter erosion of the target. Indeed, Hsu uses both his biasing or magnetizing apparatus 109 adjacent the square wafer 15 while placing a magnetron formed of magnets 23 adjacent his target 21.

There is no suggestion that Miyata's magnetron dipole ring should replace Hsu's magnetic biasing apparatus 10 adjacent the wafer. In fact, the circular geometry Miyata's dipole ring is ill suited for Hsu's square substrates (col. 5, line 18), which are better served by Hsu's rectangular magnetic biasing apparatus illustrated in FIG. 2. If any combination of Hsu and Miyata is obvious, it is to replace Hsu's magnets 23 adjacent the circular target 21 (col. 5, lines 23, 24) with Miyata's circular dipole ring, also used as a magnetron, though even this combination is suspect because of Hsu's curved target sputtering surface 20.

Rejected base claims 1 and 27 require generating a magnetic field that is substantially parallel either to the substrate surface or the support surface and rejected base claims 27 and 41 require a magnet ring disposed about the substrate or its support. As argued above, neither restriction is found or suggested in Miyata.

Yet further, Miyata's magnet ring 100 illustrated in FIG. 4 is located outside the vacuum chamber, contrary to the recitation in claim 21 that the magnet array be disposed within the sputtering chamber.

Tepman is being used for his grounded collimator and adds nothing to the arguments presented above.

Accordingly, the rejection should be withdrawn.

New dependent claims 46 and 47 have been added to emphasize the difference between

the claimed magnet array and the target magnetron, supported in the present description at page 5, line 11 and page 7, lines 19-27. It is noted that allowed method claim 27 already contains a related requirement of generating a target magnetic field from a magnetron, as well as additional functional language, thus providing additional justification for the allowance of that claim.

A new base method claim 48 and two dependent claims have been added which more generally claim a magnetic sputtering method.

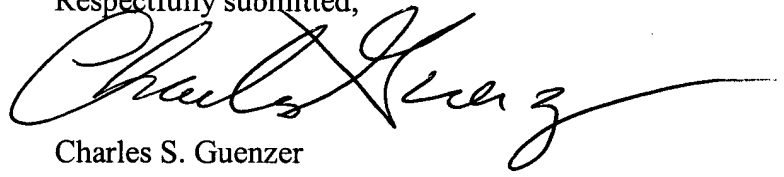
The Examiner rejects claims 23, 25, 26, 30, and 44 under 35 U.S.C. §103(a) as being obvious over Hsu, Miyata, and Tepman as further in view of Boys et al. (U.S. Patent 4,500,409, hereafter Boys). These claims, however, depend from claims believed to be in allowable form and should therefore also be allowable.

Claim 31 is allowed.

In view of the above amendments and remarks, reconsideration and allowance of all claims are respectfully requested. If the Examiner believes that a telephone interview would be helpful, he is invited to contact the undersigned attorney at the listed telephone number, which is on California time.

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